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Advanced tear film testing: Improving diagnosis and patient treatment

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Advanced tear film testing: Evidence-based diagnosis and improved patient treatment

by Eric D. Donnenfeld, MD

Ocular surface disease is the most common reason that people visit our offices, and advanced tear film testing is a completely different way of looking at the condition. Using new point-of-care diagnosis and treatment can revolutionize our practices and really make us think differently about the way we work in our offices. We want to work smarter, not harder, and have a better way to more accurately diagnose ocular surface conditions.

Advanced tear film testing is truly healthcare for the 21st century. This will become commonplace in the next four or five years, and we can all use these testing mechanisms to improve diagnosis and patient care in our offices on a daily basis today.

Changing beliefs

As the word gets out, advanced tear film testing is gaining popularity, and ophthalmologists are immediately understanding the importance of incorporating it into their practices. During the 2013 ASCRS•ASOA Symposium & Congress, we surveyed 201 physician attendees who represented approximately 102,000 cataract procedures annually. Most (64%) practiced in the United States. Attendees were surveyed before and after a symposium about advanced tear film testing to see if the content of the symposium changed their beliefs. The results were quite illuminating.

Before attending the symposium, 38% of attendees said that they thought advanced tear film diagnostics should be incorporated into the initial point of care in most patients, and 85% said that there was clinical value to incorporating advanced tear film diagnostics into their practices versus currently used diagnostics. After the symposium, these percentages increased to 73% and 100%, respectively, and both were statistically significant changes.

Additionally, attendees were asked if they strongly agree/agree that some of the new and currently used tests can reliably increase diagnostic accuracy of related disease and treatment efficiency.

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Belief Statement	Pre	Post	Mean Δ
Strongly agree/agree that the following tests can reliably increase diagnostic accuracy of related disease and treatment efficiency			
– Schirmer's testing	64%	-	-
– Corneal/conjunctival staining	93%	-	-
– Tear breakup time	92%	-	-
– Osmolarity	50%	74%	24%
– Adenovirus	18%	40%	22%
– Interferometry	21%	42%	21%
– Topography/OCT	53%	60%	7%

Average n = 150

Attendees were asked if they strongly agree/agree that some of the new and currently used tests can reliably increase diagnostic accuracy of related disease and treatment efficiency.

Program chair

Eric D. Donnenfeld, MD

Faculty

Christopher E. Starr, MD

Edward J. Holland, MD

Marguerite McDonald, MD

Using advanced diagnostics to overcome clinical challenges in ocular surface disease

by Christopher E. Starr, MD

Accurately diagnosing ocular surface diseases is not as easy as previously thought. Ocular surface patients typically present with a multitude of issues. They can have aqueous deficient dry eye and evaporative dry eye, meibomian gland dysfunction (MGD), and/or anterior blepharitis. Additionally, their eyes can be red and irritated due to infection or allergy. Other conditions, such as conjunctivochalasis, preservative toxicity, basement membrane dystrophy, eyelid malpositions, and a whole host of others, blur the picture and often co-exist. Unfortunately, our traditional diagnostic techniques are largely subjective, highly variable, often unreliable, and poorly reproducible. These techniques include Schirmer's test, tear breakup time, corneal and conjunctival staining, tear meniscus height, lid expression, and symptom questionnaires.

Basing our diagnoses of ocular surface diseases on traditional signs and symptoms is more difficult than many of us care to admit. It has been known for years that there is a very poor correlation between subjective symptoms and the objective signs of ocular surface diseases. Therefore, it is difficult for us, as doctors, to make an accurate diagnosis in the absence of signs, and it's also difficult for patients to accept an offered treatment in the absence of any significant symptoms. Additionally, it is challenging to monitor the efficacy of our treatments based on these subjective and variable endpoints. Until recently, there hasn't been any single gold standard diagnostic test for accurately establishing dry eye disease.

Diagnostic tests are often evaluated based on their positive predictive value (PPV), which is the proportion of positive tests that are true positives. Following are the PPVs of some commonly used diagnostic tools:

- Schirmer's: 31%
- Tear breakup time: 25%
- Staining: 31%
- Tear meniscus height: 33%

Tear osmolarity testing

We have been aware of the utility of tear osmolarity testing for many years, but it has always been outside the reach of the average practitioner. It has a PPV of 87% and could become the new gold standard for dry eye diagnosis; it certainly has in my practice. The American Academy of Ophthalmology agrees, stating in its most recent Preferred Practice Patterns publication that tear osmolarity is a more sensitive method of diagnosing and grading the severity of dry eye than staining, tear breakup time, Schirmer's testing, and meibomian gland grading.

Additionally, according to the 2007 Dry Eye Workshop Study (DEWS), in order to meet the new definition of dry eye disease, patients must have tear hyperosmolarity, and it is well known that osmolarity is linearly related to dry eye severity.

Meibomian gland dysfunction

There are several current challenges in the diagnosis and treatment of MGD. Aqueous and evaporative dry eye often overlap and coexist. It is common to see patients with low Schirmer's scores and rapid tear breakup times. Additionally, hyperosmolarity is present in both forms and doesn't distinguish between them. It is important to differentiate between them clinically because treatment should ideally be tailored based on whether the condition is predominantly evaporative, aqueous, or both.

It is reported that up to half of MGD can be "non-obvious MGD," in which there are very subtle signs and no overwhelming

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When attendees were asked whether they regularly consult with and adhere to the Delphi/DEWS guidelines for treating aqueous deficient dry eye and meibomian gland disease, 10% said yes before the symposium, and 36% said yes after the symposium. Additionally, attending the symposium improved attendees' confidence level in a dry eye treatment protocol, with 43% saying they had very high/high confidence before the symposium, and 67% indicating very high/high confidence after the symposium.

Similar results were observed for attendees' confidence in a red eye treatment protocol, with 32% saying they had very high/high confidence levels before the symposium and 57% saying they had very high/high confidence levels after the symposium.

Results from pre-registrant survey

In the pre-registrant survey, attendees were asked how significant of an impact they believed that dry eye and blepharitis have on outcomes after cataract and refractive surgery. Forty-one percent said they have a very significant impact, 52% said they have a significant impact, and 7% said they have little impact.

When asked about the average percentage of patients presenting for their preop consult with sufficient ocular surface dysfunction to require some treatment beyond artificial tears, attendees said that 30% of cataract patients and 25% of laser vision correction patients required treatment beyond artificial tears.

Attendees were also asked about patients who present with ocular surface disease issues. Of these, attendees believe that 27% have aqueous deficiency/evaporative dry eye, 30% have meibomian gland disease, and 43% have both.

Moving forward

Unique diagnostic point-of-service tools are now able to assess key information in the tear film. These tests allow clinicians to confidently diagnose and monitor challenging ocular surface diseases. These tools include measurement of lipid layer thickness using interferometry and OCT/topography assessment of tear breakup time, lid parallel conjunctival folds (LIPCOF), and tear meniscus height. These point-of-care tests can improve outcomes in a cost-effective manner.

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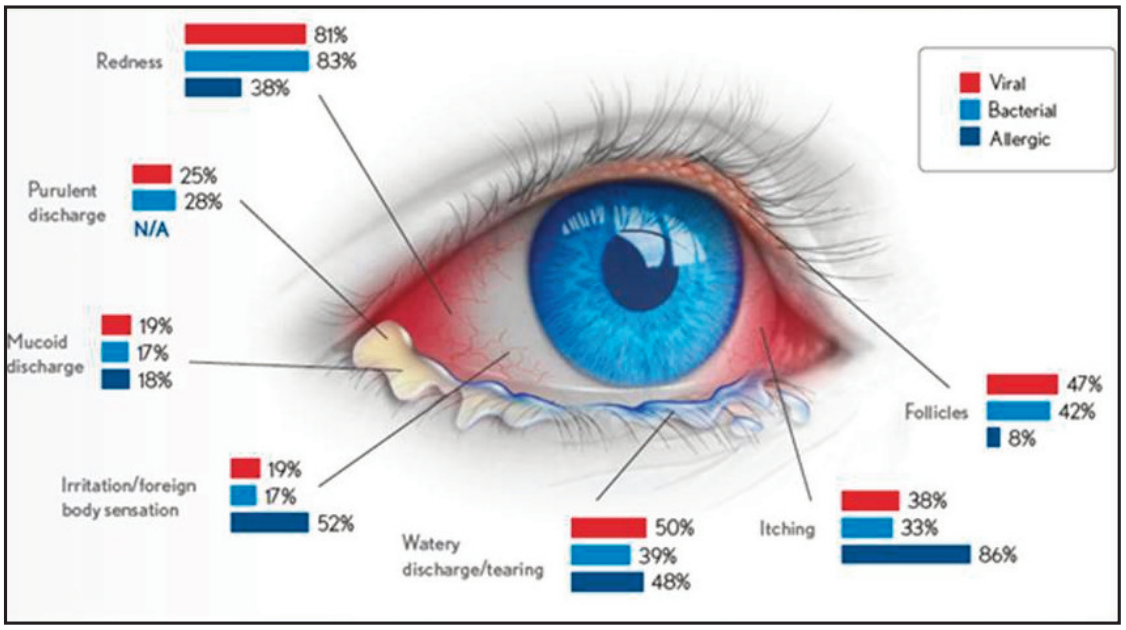

Overlapping signs and symptoms of conjunctivitis

evidence of inflammation. This makes what is commonly thought to be a minor diagnostic challenge much more difficult. Fortunately, newer point-of-care objective tests can help us to start making these differentiations rapidly and easily. Some of these tests include lipid layer interferometry, noninvasive tear breakup time, and meibography.

According to the DEWS report, MGD is a condition of meibomian gland obstruction, and it is the most common cause of evaporative dry eye. The MGD Workshop in 2011 similarly defined MGD as a chronic diffuse abnormality of the meibomian glands, commonly characterized by a terminal duct obstruction and/or qualitative and quantitative changes in the glandular secretion, and it may result in alteration of the tear film, symptoms of eye irritation, clinically apparent inflammation, and ocular surface disease or dry eye disease.

MGD can be broken down into low and high delivery states. The most common is the obstructive, non-cicatricial form of MGD.

Conjunctivitis

There are also challenges in the diagnosis and treatment of conjunctivitis. Ophthalmologists felt fairly confident about our ability to diagnose the red eye based purely on signs and symptoms until we had diagnostic tests. And like neurologists before the MRI and pediatricians before the rapid strep test, we realized that we were wrong quite often.

The common signs and symptoms of conjunctivitis, such as follicles versus papillae, redness, discharge, irritation and itching, have significant overlap among the three forms: viral, bacterial, and allergic.

There is similar difficulty differentiating between allergic conjunctivitis and dry eye disease. Many allergy patients have dryness symptoms, and many dry eye patients have itching as a common complaint.

The most common external ocular infection is adenoviral conjunctivitis. It's the most frequent virus isolated from the conjunctiva. Up to 70% of all conjunctivitis cases are viral, and up to 90% of viral cases may be adenovirus.

The significant overlap in clinical presentation among the three subtypes of acute conjunctivitis, as well as with other forms of ocular surface disease, makes an accurate diagnosis difficult when based solely on clinical exam, signs, and symptoms. It's very easy to make a diagnosis, but it's not easy to make an accurate diagnosis based solely on signs and symptoms.

Better diagnostic tools

Making an accurate diagnosis requires better diagnostic tools. Ideally, these newer tools should be highly sensitive and specific, with a high positive predictive value. They should provide quick, reproducible results, and they should be easy to use with minimal training. They should reduce chair time, not increase it, and they should allow patient comprehension and buy-in. The simplicity of "what's my number" is very engaging to patients. Ideally, these diagnostic tools would be reimbursable or revenue generating.

Unfortunately, there are always practical issues when new technology is adopted. Practices will need to consider who will do the test. Will it be the physician's responsibility or can a technician do it? Practices will also need to consider how much training is required.

Another consideration is patient flow and when the test will be done. Most dry eye-related tests should be done at the beginning of the exam before any drops go in and before any bright lights are shone in the patient's eye, potentially causing reflex tearing.

The same goes for adenoviral conjunctivitis testing. These patients should be sequestered as quickly as possible to reduce the risk of contamination, and the diagnostic test should be done as early as possible. Another consideration is the office space required to incorporate a new test. Smaller tests are not much of an issue, but larger tests can create some challenges. Where will it go in the office so that it is accessible to everyone without creating congestion in the office and in the lanes? There are also HIPAA considerations when determining office placement, and some of these tests are sensitive to temperature and humidity.

However, while there are a few issues to overcome, there are definite advantages to adopting this technology. A high-tech, cutting edge practice has many advantages, and you can differentiate your practice from others by adopting some of these devices. Certainly, these tests can be used effectively in marketing endeavors, but additionally, many of the companies that make these devices have doctor-locators on their websites that could drive new patients to your practice. Embracing many novel tests and technologies can enable a designation of "Dry Eye Center of Excellence" and can be a significant practice builder for many.

Of course, cost issues always factor into any addition that a practice makes, and upfront fees for the device must be taken into consideration. Additionally, there is the cost of consumables, and there may also be applicable click fees. Practices will need to determine upfront whether the test will be a revenue generator, a break-even test, or a loss. Remember that just because something is reimbursed doesn't mean you're going to get reimbursed what you paid for it.

However, it's important to note that even the classical tests, such as Schirmer's, staining, and tear breakup, have small costs, can take time, and technically have zero direct reimbursement.

The following are some of the new diagnostic modalities for objectively assessing ocular surface disease: optical coherence tomography, wavefront aberrometry, corneal topography, tear osmolarity, inflammatory markers (MMP-9),

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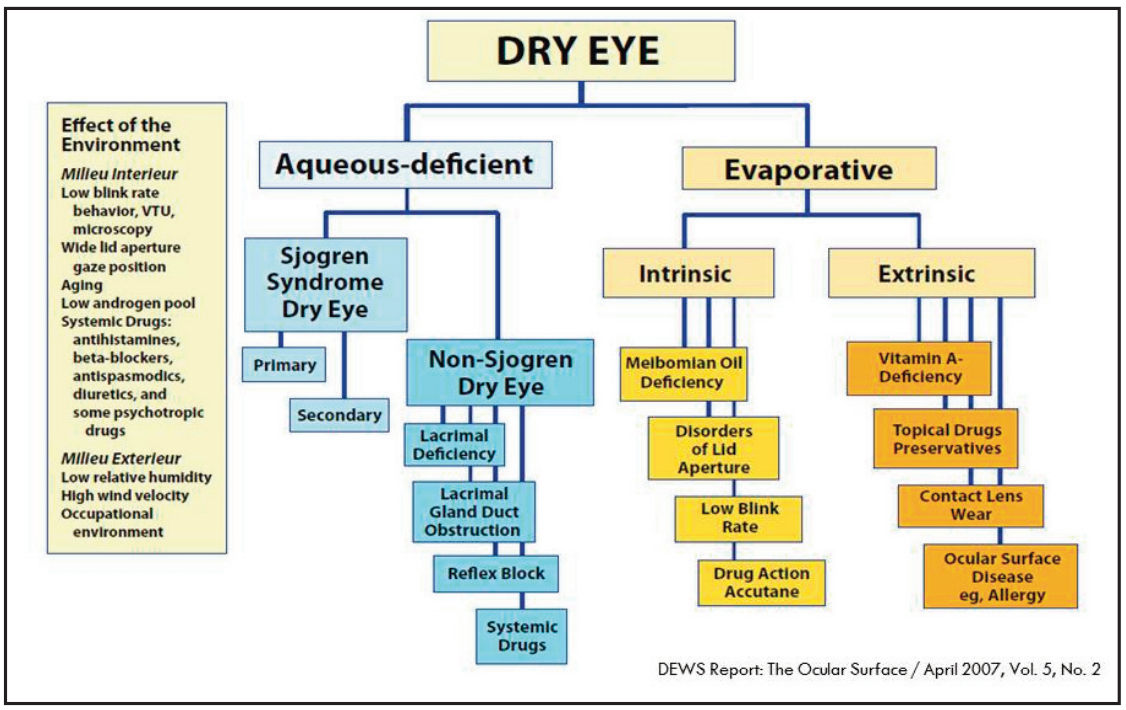
Assessing new information from the chemistry of the tear film

by Edward J. Holland, MD



Major etiological causes of dry eye

For most ophthalmologists, the way we diagnose ocular surface disease hasn't changed much in the past 20 years. However, there are two main reasons why we should consider new diagnostic tests: 1) We are not as good of diagnosticians as we think we are, and we could all benefit from additional information to help us make accurate diagnoses. 2) New point-of-service tests will make us more efficient, better clinicians. With the aging population and age-related eye disease, we all have to become more efficient to take care of the demands that will be placed on the system.

We know that the tear layer is a very complex structure. Patients who have dry eye have a marked abnormality in the quality of the tears, and all of the beneficial mediators and growth factors in the tears have disappeared, thus giving rise to the symptoms and the inflammation.

Normal meibomian glands should have a patent orifice, and we should be able to express the normal olive oil-appearing material. While there are better tests out there, expressing the glands is a quick diagnostic step that should be performed on all patients with ocular surface symptoms, and it gets us thinking about diagnosing meibomian gland dysfunction (MGD).

The DEWS report produced an elaborate breakdown of the different types of dry eye, but in practice, aqueous tear deficiency and evaporative dry eye due to MGD make up the vast majority of dry eyes.

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confocal microscopy, lipid layer interferometry, and adenovirus testing. In the future, there will likely be more and more point-of-care diagnostics with accurate answers to many of our daily clinical dilemmas.

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Osmolarity

Osmolarity has been found to be increased with decreasing flow rates, and hyperosmolarity can lead to damage of the ocular surface. It is the primary cause of discomfort associated with dry eye, and high osmolarity is associated with other inflammatory factors that we can see, such as increased MMP-9 and loss of epithelial cell-cell junctions. Researchers in the field of ocular surface disease now feel that osmolarity is a valuable marker for the disease diagnosis and severity.

Osmolarity testing is not only an initial test to help diagnose ocular surface disease, it can also show whether the treatment has had an impact and if patients are improving. It is important to know patients' osmolarity levels. A physician wouldn't think of managing cholesterol without knowing the level.

Additionally, we can use a new diagnostic tool, LipiView (TearScience, Morrisville, N.C.), to assess the thickness of the tear film. It uses interferometry to provide relative measure of the thickness of the lipid layer of the tear film. LipiView is another new test that assists with the diagnosis of MGD and the assessment of whether treatment is working.

Markers for ocular surface disease

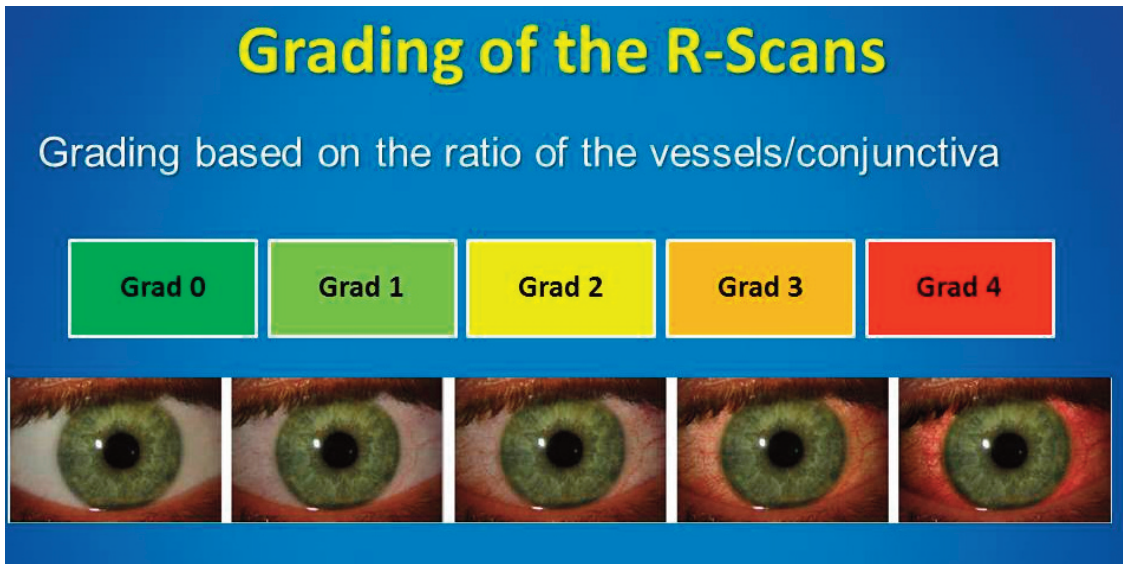
Several markers are being evaluated in ocular surface disease. For example, lactoferrin is an important molecule in the ocular surface, and changes in the lactoferrin level are associated with ocular surface disease. It has been identified as one of the tear proteins that may be part of the innate defense of the mucosal surface. Lactoferrin levels can be determined using the TearScan MicroAssay System (Advanced Tear Diagnostics, Birmingham, Ala.).

Additionally, dry eye is a multifactorial disease, and distressed epithelial cells produce elevated levels of MMP-9. Abnormal levels of MMP-9 (>40 ng/mL) have been shown to correspond with moderate to severe dry eye disease. Now, there is an in-office quick test (InflammaDry, RPS, Sarasota, Fla.) that can be done on the ocular surface to determine whether the level of MMP-9 is elevated. All of these tools will

Identifying fundamentals of how unique diagnostic tools are assessing key information in the tear film

by Marguerite McDonald, MD

In addition to the point-of-service laboratory tests that are based on the osmolarity of the tear film, there are new and unique diagnostic tools that use imaging to help assess key information about the tear film. The new tests include white light interferometry to assess the thickness of the lipid layer of the tears, automated tear film height measurement, automated and noninvasive tear film breakup time, assessment of the tear film viscosity using automated tracking of particle movement, meibography with image analysis, automated detection of bulbar and ciliary redness, optical coherence tomography (OCT) to measure tear meniscus height, and lid parallel conjunctival folds.



The R-Scan automatically detects bulbar redness.

LipiFlow/LipiView

The system from TearScience (Morrisville, N.C.) includes LipiFlow, which is the treatment aspect of the technology; LipiView, which is the diagnostic aspect; and the meibomian gland evaluator for applying a standard amount of pressure to the glands of the lower lid.

There is an assessment of the thickness of the lipid layer based on white light interferometry. The thicker the layer of oil, the more colors that are visible. So the way the light diffracts through it and the number of colors that can be seen provide extremely accurate information about the thickness of the lipid layer.

Based on this principle, LipiView uses advanced interferometric technology to capture, archive, manipulate, and store detailed digital images of the tear film's lipid layer. Interferometric color unit (ICU) statistics are calculated on a frame-by-frame basis and are plotted for approximately 1 billion data points per eye. The results are then displayed and are available for printout. LipiView provides an absolute measure of the thickness of the lipid layer of the tear film, and it provides a ratio of partial blinks to complete blinks for the duration of the exam.

The LipiView report can be used for assessment, patient education, monitoring response, prognosticating, and planning treatment.

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assist in making a correct diagnosis more rapidly and make us better and more efficient clinicians.

Adenovirus and the tear film

Adenoviral antigens can be found in the tear film, and adenovirus is the most frequent cause of infectious conjunctivitis. Additionally, it accounts for up to 90% of all viral conjunctivitis. Unfortunately, eyecare providers, including cornea specialists, are not very good at diagnosing adenovirus. In fact, only 30% to 35% of the patients seen by corneal specialists for a diagnosis of adenovirus actually had adenovirus. In other words, approximately 65% of the time, the patient had something else.

Adenovirus can live on inanimate surfaces for four to five weeks. It can shed for 14 to 16 days after initial symptoms, thus leading to the outbreaks that are often seen. Prompt diagnosis is imperative to prevent the spread of this infection.

AdenoPlus (Nicox, Sophia Antipolis, France) aids in the rapid differential diagnosis of acute conjunctivitis. It detects adenovirus with 90% sensitivity and 96% specificity, and it takes less than two minutes to complete the test and provides results in 10 minutes or less. This has the potential to significantly reduce the epidemics we now see with adenovirus.

Point-of-care diagnostics

In conclusion, point-of-care advanced tear film diagnostics will assist clinicians to be better and more efficient. New tests have the ability to do the following:

- Assess hyperosmolarity on tear film stability
- Determine meibomian gland dysfunction
- Identify MMP-9 and lactoferrin for the severity and type of dry eye disease
- Detect adenoviral conjunctivitis among acute conjunctivitis patients
- Better match the treatment of dry eye and conjunctivitis to the specific patient's condition

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Evidence-based medicine: Healthcare for the 21st century

by Eric D. Donnenfeld, MD

Evidence-based treatment using point-of-care diagnostic testing is the future of medicine because it provides objective measurements and a hard piece of information to rely on. Additionally, there's a strong correlation between point-of-care diagnostic testing and signs and symptoms. So we, as clinicians, can now emphasize other parts of our examination, and we improve the sensitivity and specificity of our diagnosis. The increased confidence in our diagnosis allows a more specifically targeted and aggressive treatment plan.

In this rapidly changing healthcare environment, clinicians need to practice smarter, increase patient flow, and empower staff to perform testing based on physician-based indications. Then, when the physician examines the patient, the diagnosis has already been suggested, and only confirmation is needed. This permits the physician to spend less total time, but more quality time, with the patient. I spend more time talking to the patient about treatment rather than the diagnosis because I already have the diagnosis right in front of me.

With the development of new point-of-care testing, we need to re-evaluate how we are approaching the patient. At Ophthalmic Consultants of Long Island, we have instituted a dry eye/meibomian gland dysfunction (MGD) protocol and a red eye protocol, both of which have worked very well.

Dry eye/MGD protocol

One goal of the new dry eye/MGD protocol is to improve diagnostic confidence with point-of-care testing to identify the type and extent of disease. We rely mostly on osmolarity levels for diagnosing dry eye, but lipid layer assessment plays a very important role, as do various topographic measurements.

New testing, like MMP-9 and lactoferrin, is still being tested in our practice, but osmolarity has become the mainstay.

This allows us to improve diagnostic confidence, spend time, make an informed evidence-based supportive diagnosis, and communicate better with the patient about disease management.

Every other specialty besides ophthalmology couldn't practice without lab tests. If physicians suspect strep throat or high cholesterol, they don't treat until they have done diagnostic testing. In fact, lab testing impacts 70% of all medical decisions, except for ophthalmology and optometry. Eyecare practitioners do not have the luxury of using reference laboratories. Now, for the first time, lab tests are available, and we have become a CLIA testing laboratory.

At Ophthalmic Consultants of Long Island, we see 180,000 patients a year (15,000 patients a month). Last month, 6,000 patients were positive for the dry eye protocol and received osmolarity testing in both eyes. So we performed 12,000 tests in our office last month.

The dry eye/MGD protocol includes the following steps:

- The patient presents with the complaint of dry eye.
- He or she is given a standardized symptoms questionnaire.
- A certified technician confirms that symptoms are present.
- Noninvasive advanced tear film testing is performed based on standing physician orders. Tests include osmolarity levels, lipid layer thickness if necessary, tear breakup time, tear meniscus height, and inflammatory mediator assessment.
- Results are interpreted from the tear film testing.
- A slit lamp exam and invasive follow-up testing are performed in the lane with the ophthalmologist to confirm the diagnosis.
- Treat accordingly.

This has resulted in improved time and cost-effective treatment of dry eye disease. Based on new literature and our personal experience, I have become an ardent supporter of omega-3 fish oils. Omega-3 consumption is 25 times less than it was 100 years ago, and because of that, aqueous deficiency, dry eye, and MGD have become an epidemic in our country.

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Keratograph 5M

The Keratograph 5M (Oculus, Arlington, Wash.) offers several ways to analyze the tear film. In addition to being an excellent Placido-based corneal topography unit, it has several new hardware and software upgrades that make it incredibly powerful in the assessment of dry eye. There are four different illumination systems and three magnification settings, depending on what aspect of dry eye is being evaluated.

The tear meniscus height can be evaluated with the new magnification changer to provide an image of the curvature along the lid margin. As the tear meniscus is not always uniform in height due to inclusions, mucous, etc., image analysis can be performed to determine the average height. Additionally, tear film breakup time can be precisely documented and the level of dry eye automatically classified; the image detection and software can "see" the dark spots in the fluorescein-stained tear film by noting the distortions in the reflected image or grid.

The viscosity of the tear film can also be determined by the Keratograph 5M using a "particle tracking" technology package. Individual particles in the tear film (meibum, dust, makeup residue, etc.) are tracked between blinks; their direction and the distance that they travel is an indication of tear viscosity.

The Keratograph 5M can also perform meibography of the eyelids. Eversion of the lids is necessary because the external lid tissue blocks the entry of light on assessment, so one has to evert the lids while the patient is looking downward. The large working distance of the Keratograph 5M allows the observation and eversion of the upper and lower eyelid. The field of view is 24 mm to image the whole upper tarsal plates and the structures of the meibomian glands. The glands are quickly illuminated and image analysis is used to calculate their area and volume.

However, not all omega-3 supplements are equally effective. Many omega-3 supplements have alcohol added to them to remove the mercury and the contaminants. But when you add alcohol, you degrade the fish oil. It goes from a natural triglyceride, which is a normal, found-in-nature substance, to an ethyl ester. As an ethyl ester, the fish oils don't absorb well, which is why many who ingest them complain of gas or burping. Obviously, this does not occur with normal fish consumption. Re-esterified triglycerides have three times more absorption, and high levels of absorption result in improved response to therapy. Three re-esterified triglyceride forms that have had the toxins removed are available from Physician Recommended Nutriceuticals (PRN, Plymouth Meeting, Pa.), Carlson Laboratories (Arlington Heights, Ill.), and Nordic Naturals (Watsonville, Calif.). Patients must be educated that all fish oils aren't created equal.

I put all of my surgical patients on PRN Dry Eye Omega Benefits as soon as I see them, and they continue taking it for a minimum of three months postoperatively. This has had a tremendous impact on postoperative surgical results by reducing dry eye and improving ocular surface disease.

In addition to omega-3s, over-the-counter artificial tears and prescription anti-inflammatories are important treatment options. Punctal plugs are a solid secondary therapy when a patient is not responsive to tears and immunomodulation with cyclosporine.

For MGD, I use the LipiFlow Thermal Pulsation System (TearScience, Morrisville, N.C.). The system applies heat to the palpebral surfaces of the upper and lower eyelids directly over the meibomian glands. Graded pulsatile pressure is delivered to the outer eyelid.

LipiFlow liquefies and evacuates obstructed glands.

"In this rapidly changing health-care environment, clinicians need to practice smarter, increase patient flow, and empower staff to perform testing based on physician-based indications."

LipiFlow is much more effective than hot compresses because hot compresses are applied to the outside of the eye. The meibomian glands are on the inside of the eyelids, and LipiFlow applies heat to the inside of the eyelid directly to the meibomian glands. The system provides a heating level of more than 40 degrees C for 12 minutes that heats up the oil glands safely and effectively and then slowly, pulsatingly, expresses them.

LipiFlow studies have shown post-treatment improvement in meibomian

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In the near future, the Meibo-Scan will be able to tell us where meibomian gland dropout occurs first in MGD; this technology is opening the door to a deeper understanding of this disease.

The Keratograph 5M also offers the R-Scan, which automatically detects bulbar redness. Even cornea fellowship trained experts can disagree on the staging of conjunctival erythema when asked to examine a given patient. Now, ophthalmologists can use a standardized, automated system to document exactly how much erythema is present.

The R-Scan technology is based on the detection of the blood vessels in the black and white representation of the conjunctiva. The grading is a ratio between the vessels and the rest of the conjunctiva.

Grading based on this ratio can allow ophthalmologists to very carefully track how red the eye is and how it responds to treatment. Grade 0 is found only in children and cadavers. Grade 1 and Grade 2 are more normal for adults.

Optical coherence tomography

OCT is widely available in most offices, but is not typically used for dry eye diagnosis by most doctors. It is noninvasive, objective, quick, and easy. It measures the tear meniscus height, and it has a diagnostic sensitivity of 92% and a specificity of 90% for dry eye. It also measures the lid parallel conjunctival folds (LIPCOF), which has a positive predictive value for dry eye of 93% and a very strong correlation with symptoms.

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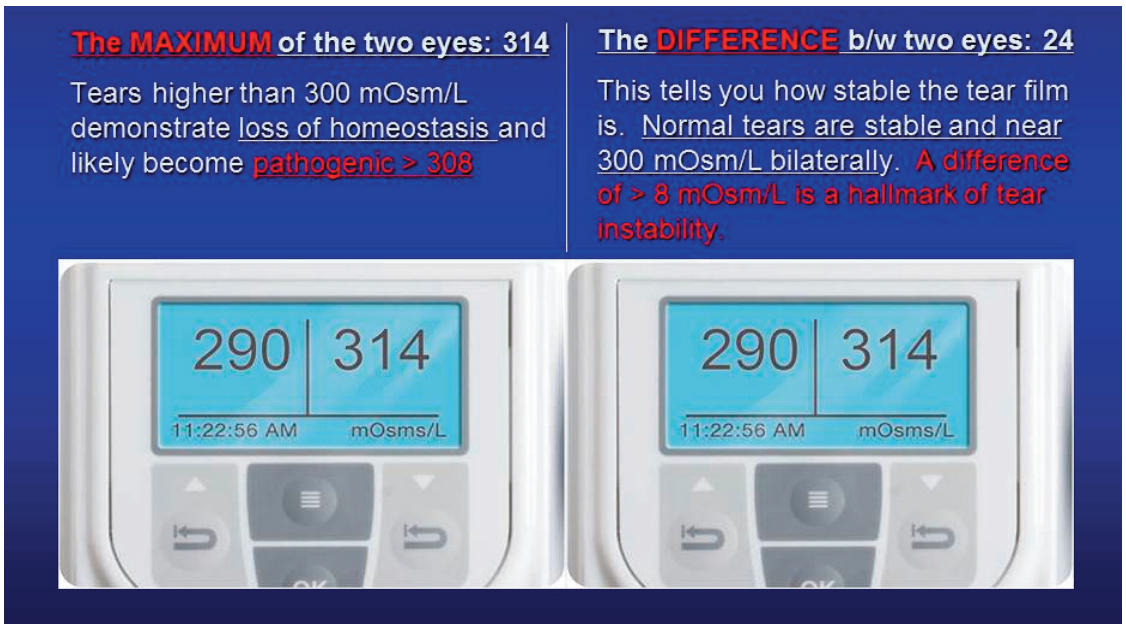
gland secretion scores, tear film breakup time, and reduction in dry eye symptoms.[1]

Strong dry eye/MGD testing protocols also directly impact outcomes. I have found that these testing protocols improve outcomes in both refractive and cataract surgery. The biggest concern I had with osmolarity when I first saw this test was that there was variability in the numbers. I wondered how a test can be good when one eye is 290 and the other eye is 314. However, there is a very good reason for this. The more severe the dry eye, the more unstable the tear film. Thus, there is minute-to-minute, day-to-day variation that is reflected in these variable numbers. A patient with normal osmolarity (no dry eye disease) will tend to have very consistent numbers, usually below the critical threshold of 308 mOsm.

It is important to note that the variability is more important than the number itself. If you see a difference of more than 8, you are almost certainly dealing with dry eye disease.

We can measure tear osmolarity extremely accurately. Dry eye disease and osmolarity are 85% to 90% correlated. Always measure both eyes. The higher of the two measurements is the reference. As severity increases, there is an increased chance that the left and the right eyes will be different, but due to the unstable tear film, the more severe eye may change from blink to blink, so treat both eyes the same. Hyperosmolarity should be addressed as it may compromise quality of vision, cause chronic inflammation, and potentially damage the ocular surface.

"By offering these point-of-care tests, you allow patients to have expert care done in a timely fashion, and you practice smarter and better medicine."



In osmolarity testing, variability is more important than the number itself.

Red eye protocol

Acute conjunctivitis is highly infectious. There are three major subtypes (viral, allergic, and bacterial) that often have a confusing presentation. It is accurately diagnosed only 27% to 50% of the time.

The red eye protocol has three goals:

- Improve diagnostic confidence with a point-of-care system to rule out or confirm the presence of adenovirus. The AdenoPlus (Nicox, Sophia Antipolis, France) detects adenovirus with 90% sensitivity and 96% specificity.
- Minimize the risk of patients spreading disease.
- Permit ophthalmologists to focus time with the patient on patient management strategies, make a more informed, evidence-supported diagnosis, and treat appropriately.

Our red eye protocol includes the following steps:

- The patient presents with red eye and is immediately triaged by the front desk to an isolated exam room.
- The technician confirms the presence of acute conjunctivitis.
- The AdenoPlus diagnostic test is performed. It is a two-minute test, and results are available in 10 minutes.

If the test is positive, patients are given a written protocol for treatment that includes instructions to apply lubricating drops and cold compresses to the infected eye. No antibiotics are necessary, and many increase infectivity and duration of viral shedding. Consider using the antiviral Zirgan (ganciclovir, Bausch + Lomb, Rochester, N.Y.), which has been shown in vitro to be effective against adenovirus. Patients are advised to refrain from work until the adenovirus is resolved.

If the test is negative, continue the diagnosis to identify whether the conjunctivitis is bacterial or allergic. Consider antibiotic or antihistamine therapy (or a combination). Follow-up or refer if there is decreased vision, pain, or lack of improvement over seven days. Patients may return to work the same day.

Exam rooms containing patients with confirmed conjunctivitis are vigorously cleaned with a dilute bleach to prevent epidemic spread.

Every red eye has the AdenoPlus test done. It saves a lot of time, is cost effective, and allows our practice to be more efficient.

Gaining information from these point-of-care diagnostic tests can increase diagnostic accuracy, allow effective treatment, and increase patient satisfaction. By offering these point-of-care tests, you allow patients to have expert care done in a timely fashion, and you practice smarter and better medicine.

Reference

1. Lane SS, et al. A new system, the LipiFlow, for the treatment of meibomian gland dysfunction. *Cornea.* 2012;31(4):386-404.

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